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(4)

Exemplary

Some hypertrophy & atrophy
of Skull

SENILE HYPERTROPHY AND SENILE ATROPHY OF THE SKULL.

BY

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Read May 27th, 1890.

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I AM desirous of directing the attention of the Society, in a more especial manner than has hitherto been done, to two changes of opposite nature which are not very infrequent in the skulls of elderly persons, affecting chiefly the vault of the skull, both of which, so far as I know, are peculiar to this part of the skeleton, and for neither of which is it easy to offer a thoroughly satisfactory explanation. One of these consists in an increase of bony material and weight—a hypertrophy; the other in a diminution of bony material and weight—an atrophy.

It is well known that shrinkage of the brain-substance, associated with old age, general wasting or prolonged alcoholism, is commonly attended with an increase of fluid in the meshes of the pia mater or a thickening of the calvarial part of the skull or with both these conditions. Both conditions, we may judge, proceed from the same cause, viz. a lessening of the pressure in the cranial cavity resulting from the brain-shrinkage, a consequent dilatation of vessels and a slowing of circulation in them which leads to an increased filtration of their contents, serous and cellu-

lar, and a dropsy of the pia mater or a hypertrophy of the calvaria or both. The condition is comparable with that of a part under a bell-glass (or cupping-glass) or other exhausted receiver; and the results are similar to those which take place in chronic œdema, viz. an increase not only of the fluid or serous components of the blood but of the cell-constituents also, and an increase of tissue-development. The latter, indeed, is not an uncommon sequence of prolonged dropsical condition from whatever cause it arises. Thus prolonged œdema of the lower limbs is often attended with thickening of the connective tissues, as illustrated in elephantiasis arabum, where the hyperplasia may extend to the bones causing thickening of them with nodular outgrowths; and thickening and sclerosis of bones readily follows upon congestion of blood-vessels induced by various causes, that is to say, the greater or less nutrition of these tissues, of bone in particular,—their hypertrophy or atrophy—is dependent, partly, upon their own nutritive energies, partly, upon the greater or less supply of nutritive material and tissue-forming elements, and, partly, upon the more or less true balance between these two. And it may be, or rather must be, a feature of proper and properly regulated nutritive force to appropriate the required nutritive material and no more—not merely to turn to account, but to control and keep within bounds, the energies of the leucocytes with which they are supplied. The paradox may thus come about that in the connective tissues, more particularly bone and fat, under certain circumstances, a decrease of nutritive force may lead to an increase of nutrition or hypertrophy; and it may be that the same failure of nutrition which in the aged person causes wasting or atrophy of the highly organised brain-tissue may cause thickening or hypertrophy of the more lowly organised brain-case, first, by inducing an increased afflux of blood there, and, secondly, by disabling the osseous tissue of the skull from controlling the ossifying tendencies of the blood-elements effused into it.

Whatever may be the view of the precise pathology of

the condition, it seems to have its analogue in the enlargement of the prostate and the thickening of the arteries so common in old people.

The coloured drawings (Pl. III, and Pl. IV, figs. 1 and 2) show the congested state of the diploë and of the inner tables of the skull-vault from an alcoholic man, aged 50, who died in Addenbrooke's Hospital of apoplexy in the early part of this year. The skull-wall is somewhat thickened by bone deposit on the interior, and is slightly denser than natural. I have lately seen a similar, though not so marked, congestive condition in the skull of a man aged 73; and the large size of the vascular canals often seen on the interior of the senile skull renders it probable that a state of congestion is not uncommon in the vessels of this part in those who are advanced in life.

The thickening of the skull-wall in old people takes place chiefly, if not exclusively, on the interior, and is commonly first and most marked beneath the domes of the frontal bone, on the two sides of the median line, over the part, that is, of the frontal lobes where brain-shrinkage is first and most marked. It alters the inner contour of these domes, flattening them, or even causing them to bulge, on the interior. After a time it affects the whole of the frontal bones and the rest of the vault, and may reach the base, thus extending over all the interior of the skull. In some cases the frontal and parietal bones thus thickened are cancellous, the diploë being increased and advancing upon the receding inner table, and there may be little or no increase of weight. In other cases, and more frequently, the inner table is thickened and bony deposit takes place in the diploë, which is thereby condensed; and the skull-wall is not only thickened but rendered throughout denser and heavier. In some the condensation or obliteration of the diploë has taken place without much thickening of the skull-wall. It is the increase at the expense of the cranial cavity which distinguishes the thickening of the skull in old age and in other cases of brain-shrinkage from the thickening that

takes place in osteitis deformans and some other low inflammatory affections, for in these the increase is caused by addition to the *exterior*.

The following specimens in the Cambridge Pathological Museum illustrate these points :—1. A nearly edentulous skull with great thickening of the wall and increase of the diploë except at the base, the thickening being at the expense of the cranial cavity. In this case there is not much increase of weight. 2. An edentulous skull without lower jaw and with atrophied superior maxillary and facial bones, but with thick dense skull-wall, weighs 34 oz. 3. The edentulous skull of an aged female with much wasted maxillary and facial bones, weighs $24\frac{1}{2}$ oz. The bones of the cranium are not thick but rather dense, and the ridges in the interior are somewhat pronounced. 4, 5, 6. Three skulls without lower maxillæ, edentulous, and with the usual thinning of the superior maxillary and facial bones, weigh respectively $28\frac{1}{2}$ oz., 28 oz., and $26\frac{1}{2}$ oz. 7. The skull of a man reputed to have died at 104 from which the lower jaw and all the back part (about a quarter of the whole cranium) has been removed, and which is edentulous and with wasted facial bones, weighs 17 oz. 8. The lower part of an edentulous and evidently very aged skull from which the upper part has been removed a little above the orbits, weighs 15 oz. 9. A thick dense piece of the upper part of the skull from a woman aged 80. In all of them, except No. 1, the bones are dense and more or less thickened; there has been addition of osseous matter interstitially as well as upon the inner surface; and the contrast between the thick, heavy, dense cranium and the thin light facial bones is marked in all these instances. I have long been in the habit of illustrating this as well as the contrast with the other bones of the skeleton by showing the skull and thigh-bone which I took from a woman reputed to have died at 103, and which are in the same museum. Although only one tooth remains, the alveolar processes are nearly gone, and though the maxillary and other facial bones are thin and

light, yet the skull weighs $28\frac{1}{2}$ oz., which is above the ordinary weight of the adult skull in which the teeth remain. The increase of weight is due to the thickness and density of the cranial bones, the tables being thick and the diploë dense. The encroachment upon the cranial cavity is, as usual, most marked under the frontal domes, but there has been some deposit upon the whole of the interior. The thigh-bone of this person, though large and well formed, weighs only 5 oz.; the reduction of weight being caused by absorption of the cancelli and thinning of the bone-wall from the interior. The other bones of the skeleton were in a similar atrophied condition; and the want of correspondence between the thick, heavy skull and its fragile supporters was very striking. It should be said that the old woman had latterly been bedridden.

The problem of the cause of the ill-assorted condition of these bones—the dense heavy skull and the light porous fragile thigh-bones in the same person—is not very easy to solve. The increase and density of weight in old people is, so far as I know, quite peculiar to the skull-wall. All the other bones, as age advances, become lighter and undergo absorption, which commences and proceeds most rapidly in the cancellous or most vascular parts. This, it is true, is often accompanied by some addition to the exterior in the form of bony outgrowths into the periosteal and tendinous surroundings; but these are slight and by no means compensate for the absorption within and the loss of weight attendant thereon. It is this absorption and thinning of the cancelli, upon the strength as well as the perfection of arrangement of which the upper part of the thigh-bone is much dependent, that renders fracture in that situation so liable to occur in elderly persons. I can only suppose that fatty growth dominates in the skeleton generally more than it does in the skull, and that the same failure of nutritive force which leads in some cases to *bone-formation* in the latter, leads to *bone-absorption* and fatty degeneration in the former.

The other change incidental to age which is also pecu-

liar to the skull is ATROPHY taking place from the *exterior*, whereby the bones are rendered thinner and the cranium proportionately smaller. This is common to all the bones of the skull, affecting the maxillary bones in an especial degree, and the other facial bones more or less, all these becoming reduced in calibre as well as in thickness of their walls, and the face becoming proportionately smaller. In the calvarial parts the change is usually more marked than in the rest of the skull-wall. The outer table recedes, encroaching upon the diploë, and approaching or coalescing with the inner table, so that the bone may be composed of only one thin brittle table. It is a curious process by which this change takes place, for the absorption of the outer table is not attended with any roughening of the exterior. Absorption and deposition go on together, almost at the same spot. While the outer hard laminæ are being removed by the former, the subjacent laminæ are becoming condensed by the latter, and when these again become the subjects of absorption the layers next beneath them become the seat of deposition. Similar changes are observed in the bones of the skull and of other parts when absorption is caused by pressure, as by tumours and sometimes by aneurysms, the lowered or depressed surface being usually smoothed by a filling-in of the cancelli accompanying or preceding the removal of the exterior, and accordingly the part looks as if it had been pressed or beaten in, and so differs from the rough, ragged, gnawed condition caused by cancer or ulceration.

In some instances this absorption takes place uniformly, the several parts of the skull-wall becoming equally thinned, and the entire skull being reduced in size and still more in weight, as shown by the following examples in the Cambridge Museum: An edentulous skull with lower jaw weighs only 15 oz., and the greatest circumference is $19\frac{3}{4}$ inches. It is very thin, yet the diploë is in fair proportion. There is some recent bone-deposit in the interior, and the meningeal grooves are large. Another, without the lower jaw, and with a circumference of

19½ inches, weighs 11½ oz. A third, from a very aged female, with the lower jaw, weighs 14 oz., the greatest circumference being 20¼ inches. The entire skeleton of this person weighs only 88 oz., though it is evidently that of a fine person, inasmuch as it measures 5 feet 8 inches, the thigh-bones measuring 18¼ inches and the angles of the neck with the shaft being 130°.

What are the causes which determine the incidence of one or the other of these very opposite changes—increase of thickness, with commonly increase of density and weight, on the one hand, and decrease of thickness, with decrease of weight, on the other hand—I cannot tell.

Though commonly, as I have said, the atrophic thinning and removal of the outer table, affects the whole of the calvarial part of the skull in an equal, or nearly equal, manner, yet in some instances it does so very unequally. It has an especial tendency to attack symmetrically the parietal bones between their sagittal or mesial parts and the parietal protuberances, causing those remarkable depressions of which specimens are to be found in most museums, and of which there are nine in the museum at Cambridge and four in the College of Surgeons, one of the latter being a well-formed edentulous Egyptian and one a Wallachian gipsy woman, aged 82, from the Barnard-Davis Collection.¹ They present, on the whole, much similarity, being usually ovoid, measuring three or four inches from before backwards and two or three transversely. At the deepest or middle part the inner layer of the bone may be exposed, reduced to extreme thinness or even quite removed, but it is never, so far as I have seen, indented—that is to say, the inner contour of the skull-wall is not altered. This is shown in Pl. IV, figs. 3 and 4. The surface is smooth, though in a few instances it is slightly rough and marked by vascular foramina; and in the specimen from which Pl. IV, fig. 4, is taken it is traversed by

¹ These were described by Mr. Eve at the Pathological Society ('Lancet,' February 22nd, 1890, p. 404). One of the Cambridge specimens is an edentulous ancient Egyptian skull.

grooves for the meningeal vessels which emerge from the sides and have come to appear on the exterior of the skull. The circumference rises, or shelves, rather suddenly. This is least marked in front and behind, and most marked at the outer border, which often reaches, but does not exceed, the temporal ridge; and the outer border is nearly straight, whereas the inner one is more convex.

These depressions are met with in every stage from a slight, scarcely perceptible, alteration of the normal level to a thinning down to, or through, the inner wall. I am not aware that they are attended with any symptoms or productive of any ill result, though they may render the effects of a blow serious or even fatal. This was shown by a case under the care of Mr. Wherry. A lady, aged 90, fell upon the back of her head, was taken up insensible, and soon died. The parietal depressions, as seen in Pl. IV, fig. 4, are unusually large and extensive, and numerous fractures had taken place through them and into the surrounding bones. They are of irregular shape, and there are islands in which the bone has been less removed than in other parts. In a few instances they are accompanied by similar depressions in other parts of the skull, occasionally in the frontal bone but more commonly in the hinder sagittal parts of the parietals (see Pl. IV, figs. 2 and 3). Some of these latter are more circular, resembling the depressions in the so-called pewter-pot fracture, but without any inflection of the inner table or any fissure; and I have never seen these depressions in other parts so deep as those on the sides of the parietals. In a specimen at Munich the depressions in the usual situation of the parietals are circular in outline; and in one, at Vienna, they are further back than usual, being near the back of the parietals. The depressions look as if the outer layers of the skull had been filed or planed away; but the surfaces are commonly smooth, showing that the process of bone-formation was coincident with that of bone-absorption.

In most instances the skulls thus affected are thin and light, the thinning having taken place from the exterior, so

that the canals for the meningeal vessels are nearer the external surface than is normal ; and these canals are often deepened internally by some bony deposit which extends more or less over the whole of the interior of the skull ; and, in the specimen represented in Pl. IV, fig. 4, as already noticed, they have, by virtue of the absorption on their exterior and deposition on their interior, come to be on the outer surface of the thin layer which remains at the bottom of the depressions ; and they are seen passing on it to the thicker edges at the margins of the depressions, where they disappear. These canals are quite as large and abundant as usual, or more so ; there is therefore no evidence of diminution of vascularity at the parts affected or elsewhere.

It is further to be observed that the absorption or atrophy which produces these depressions may be associated in the same skull with the opposite, viz., thickening and condensation or hypertrophy. One of the specimens in the Cambridge Museum, a calvaria which I took from a woman, aged 73, who died of apoplexy, is very thick, half an inch in the frontal part, also dense and heavy, weighing 18 oz. The thickening is evidently due to bone-formation on the interior which, especially in the frontal region, is remarkably uneven, knotty, and craggy. The parietal depressions, which occupy the usual position and present the usual features, have not reached the internal table because it has receded from them ; and the skull-wall at their deepest part has about the normal thickness and more than the usual density. In the specimen from the woman, aged 90 (Pl. IV, fig. 4), where the depressions are so large, the frontal bone is denser than usual and is thickened with hard knots or tubercles on the interior ; and there is similar deposit in the vicinity of the depressions, though the depressions themselves are free from it.

I have been much puzzled to account for these remarkable and symmetrical parietal depressions—these freaks, as it were, of senile process. That they are the result, not, as I once thought possible, of some congenital defect, but

of senile and probably atrophic process, I can no longer doubt, for all the complete skulls in which I have seen them are edentulous, and give other evidence of senile change. That the excesses in the atrophic process are not altogether confined to this particular situation is shown by the occasional occurrence of similar depressions in other parts, more particularly in or near the sagittal suture. But there must be some special cause for this part of the parietal bones being so liable to it and for its advancing here so much more than elsewhere. The cause does not seem to be related to anything in the development, the growth, the texture, the blood-supply or the nutrition of the part; nor to its being subject to the great variation of level, observed by comparing the ill-filled skull of the negro with the well-expanded oval dome of the European and with the squeezed-out parietals in the flattened heads of South American tribes. It cannot be said, as suggested by Mr. Eve, to be the part last ossified or to be in the situation of the parietal foramen. It is indeed the part into which ossification early spreads as it advances from the central parietal protuberance towards the middle line.

In default of other cause, it seems to me that the pressure of the occipito-frontalis tendon, stretched upon and playing over this the most prominent part of the vertex, deserves consideration. The appearance of the depressions is suggestive of pressure; and their shelving front and hinder edges are suggestive of pressure from this source; while their outer margins, which are nearly straight, are limited to the range of the tendon of the occipito-frontalis, and do not ever exceed it. Some countenance is given to this view by the observation in some senile skulls of deep depressions, though I believe these are to some extent inbendings, in the fore part of the temporal fossæ, which are obviously due to the pressure of the thick anterior portions of the temporal muscles.

(For report of the discussion on this paper, see 'Proceedings of the Royal Medical and Chirurgical Society,' Third Series, vol. ii, p. 122.)



DESCRIPTION OF PLATE III.

Senile Hypertrophy and Senile Atrophy of the Skull (GEORGE
MURRAY HUMPHRY, M.D., F.R.S.).

Calvarial part of skull of an alcoholic man, æt. 50, who died of apoplexy, showing congestion of the inner table, which, at parts, was very marked. At all these parts the interior of the skull was thickened by bony deposit causing elevations of the inner lobe.

DESCRIPTION OF PLATE IV.

Senile Hypertrophy and Senile Atrophy of the Skull (GEORGE
MURRAY HUMPHRY, M.D., F.R.S.).

FIG. 1.—Section of Plate III.

FIG. 2.—Skull, showing depressions on parietal bones between sagittal parts and tubera parietalia, also one in middle line.

FIG. 3.—Section of the same through the median and lateral depressions.

FIG. 4.—Effects of extensive absorption taking place somewhat irregularly on parietal bones. The patient, a woman *æt.* 90, died from fractures through the thinned bones caused by a fall.

The view is from behind, and the fore part is much foreshortened.



